

Docket No.: 971480A

Divisional Application of
Serial No.: 08/981,654

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Divisional Application of U.S. 08/981,654:

Yasushi KANEKO et al.

Serial No.: **NEW**

Group Art Unit: **2871** (Expected)

Filed: **June 25, 2001**

Examiner: **D. Nguyen** (Expected)

For: **LIQUID CRYSTAL SHUTTER AND METHOD OF DRIVING
THE SAME**

PRELIMINARY AMENDMENT

Commissioner of Patents
Washington, D.C. 20231

Date: June 25, 2001

Sir:

This is a Preliminary Amendment for the above-captioned Divisional application, concurrently filed herewith. Please amend the above-captioned Divisional application as follows:

IN THE SPECIFICATION:

Page 15, beginning on line 9:

-- Fig. 4 shows arrangement angles of the lower polarizing plate 8 and the transmittance of the liquid crystal shutter, obtained when the lower polarizing plate 8 is rotated counterclockwise from the direction 12 in which the

intermediate liquid crystal molecules are orientated, with the intersection angle fixed at 90° between the absorption axis 13 of the lower polarizing plate 8 and the absorption axis 14 of the upper polarizing plate 9 in a 240° twisted liquid crystal device having a value of $\Delta n d$ equal to 800nm.

IN THE CLAIMS:

Please cancel claims 1-3 without prejudice and amend claims 4-18 as follows:

Claim 4. (Amended) In a liquid crystal shutter, including

a liquid crystal device including a nematic liquid crystal sealed in between a first transparent substrate and a second transparent substrate on whose inner surfaces are formed respective transparent electrodes, said liquid crystal device having a twisted angle equal to or greater than 180° , and

a pair of polarizing plates between which are sandwiched said first transparent substrate and said second transparent substrate, said polarizing plates having respective absorption axes which are substantially orthogonal to each other, said absorption axes of said polarizing plates being angled within a range of $\pm 40^\circ$ to $\pm 50^\circ$ relative to a direction in which intermediate liquid crystal molecules are orientated, said direction indicating a direction of orientation of said liquid crystal in an intermediate portion in a direction of thickness of said liquid crystal device,

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a method of driving the liquid crystal shutter, comprising the steps of:

dividing a single drive term of said liquid crystal shutter into a reset term during which all pixels of said liquid crystal shutter are rendered closed and a scan term during which all the pixels or predetermined pixels are rendered opened or half-opened; and

making a duration of said scan term shorter than a holding time taken for a transmittance of said liquid crystal shutter to start to lower after it has reached its maximum with no driving voltage applied to said liquid crystal shutter.

Claim 5. (Amended) A liquid crystal shutter driving method according to claim 4, further comprising:

applying a positive or negative driving voltage to said liquid crystal shutter during a partial period with said scan term, setting said driving voltage to 0V during a remaining period, and varying said period during which said driving voltage is set to 0V in order to perform a gradation display.

Claim 6. (Amended) A liquid crystal shutter driving method according to claim 4, further comprising:

varying the voltage applied to said liquid crystal shutter in said scan term from 0V in order to perform a gradation display.

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Claim 7. (Amended) A liquid crystal shutter driving method according to claim 4, further comprising:

controlling a single driving term of said liquid crystal shutter, depending on an operating temperature, so as to be increased at a time of a low temperature but reduced at a time of a high temperature.

Claim 8. (Amended) In a liquid crystal shutter, including

a liquid crystal device including a nematic liquid crystal sealed in between a first transparent substrate and a second transparent substrate on whose inner surfaces are formed respective transparent electrodes, said liquid crystal device having a twisted angle equal to or greater than 180° , and

a pair of polarizing plates between which are sandwiched said first transparent substrate and said second transparent substrate, said polarizing plates having respective absorption axes which are substantially orthogonal to each other, said absorption axes of said polarizing plates being angled within a range of $\pm 40^\circ$ to $\pm 50^\circ$ relative to a direction in which intermediate liquid crystal molecules are orientated, said direction indicating a direction of orientation of said liquid crystal in an intermediate portion in a direction of thickness of said liquid crystal device,

a method of driving the liquid crystal shutter, comprising the steps of:

assigning a single driving term of said liquid crystal shutter to a scan term during which all pixels or predetermined pixels of said liquid crystal shutter are rendered opened or

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half-opened, and controlling said scan term, depending on an operating temperature, so as to be lengthened at a time of a low temperature but shortened at a time of a high temperature.

Claim 9. (Amended) In a liquid crystal shutter, including

a liquid crystal device including a nematic liquid crystal sealed in between a first transparent substrate and a second transparent substrate on whose inner surfaces are formed respective transparent electrodes, said liquid crystal device having a twisted angle equal to or greater than 180° , and

a pair of polarizing plates between which are sandwiched said first transparent substrate and said second transparent substrate, said polarizing plates having respective absorption axes which are substantially orthogonal to each other, and

wherein $\Delta n d$ lies within a range of 600 to 900 nm, said $\Delta n d$ being the product of a birefringence Δn of said nematic liquid crystal and a gap d between said first transparent substrate and said second transparent substrate,

a method of driving a liquid crystal shutter, comprising the steps of:

dividing a single drive term of said liquid crystal shutter into a reset term during which all pixels of said liquid crystal shutter are rendered closed and a scan term during which all the pixels or predetermined pixels are rendered opened or half-opened; and

making the duration of said scan term shorter than a holding time taken for a transmittance of said liquid crystal shutter to start to lower after it has reached its maximum with no driving voltage applied to said liquid crystal shutter.

Claim 10. (Amended) A liquid crystal shutter driving method according to claim 9, further comprising:

applying a positive or negative driving voltage to said liquid crystal shutter during a partial period within said scan term, setting said driving voltage to 0V during a remaining period, and varying said period during which said driving voltage is set to 0V in order to perform a gradation display.

Claim 11. (Amended) A liquid crystal shutter driving method according to claim 9, further comprising:

varying the voltage applied to said liquid crystal shutter in said scan term from 0V in order to perform a gradation display.

Claim 12. (Amended) A liquid crystal shutter driving method according to claim 9, further comprising:

controlling a single driving term of said liquid crystal shutter, depending on an operating temperature, so as to be increased at a time of a low temperature but reduced at a time of a high temperature.

Claim 13. (Amended) In a liquid crystal shutter, including
a liquid crystal device including a nematic liquid crystal sealed in between a first transparent substrate and a second transparent substrate on whose inner surfaces are formed

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respective transparent electrodes, said liquid crystal device having a twisted angle equal to or greater than 180° , and

a pair of polarizing plates between which are sandwiched said first transparent substrate and said second transparent substrate, said polarizing plates having respective absorption axes which are substantially orthogonal to each other, and

wherein $\Delta n d$ lies within a range of 600 to 900 nm, said $\Delta n d$ being the product of a birefringence Δn of said nematic liquid crystal and a gap d between said first transparent substrate and said second transparent substrate,

a method of driving a liquid crystal shutter, comprising the steps of:

assigning a single driving term of said liquid crystal shutter to a scan term during which all pixels or predetermined pixels of said liquid crystal shutter are rendered opened or half-opened, and controlling said scan term, depending on the operating temperature, so as to be lengthened at a time of a low temperature but shortened at a time of a high temperature.

Claim 14. (Amended) In a liquid crystal shutter, including

a liquid crystal device including a nematic liquid crystal sealed in between a first transparent substrate and a second transparent substrate on whose inner surfaces are formed respective transparent electrodes, said liquid crystal device having a twisted angle equal to or greater than 180° , and

a pair of polarizing plates between which are sandwiched said first transparent substrate and said second transparent substrate, said polarizing plates having respective

absorption axes which are substantially orthogonal to each other, said absorption axes of said polarizing plates being angled within a range of $\pm 40^\circ$ to $\pm 50^\circ$ relative to a direction in which intermediate liquid crystal molecules are orientated, said direction indicating a direction of orientation of said liquid crystal in an intermediate portion in a direction of thickness of said liquid crystal device,

wherein $\Delta n d$ lies within a range of 600 to 900 nm, said $\Delta n d$ being the product of a birefringence Δn of said nematic liquid crystal and a gap d between said first transparent substrate and said second transparent substrate,

a method of driving a liquid crystal shutter, comprising the steps of:

dividing a single driving term of said liquid crystal shutter into a reset term during which all pixels of said liquid crystal shutter are rendered closed and a scan term during which all the pixels or predetermined pixels are rendered opened or half-opened;

making the duration of said scan term shorter than a holding time taken for a transmittance of said liquid crystal shutter to start to lower after it has reached its maximum with no driving voltage applied to said liquid crystal shutter.

Claim 15. (Amended) A liquid crystal shutter driving method according to claim 14, further comprising:

applying a positive or negative driving voltage to said liquid crystal shutter during a partial period with said scan term, setting said driving voltage to 0V during a remaining period, and varying said period during which said driving voltage is set to 0V in order to perform a

polarizing plates being angled within a range of $\pm 40^\circ$ to $\pm 50^\circ$ relative to a direction in which intermediate liquid crystal molecules are orientated, said direction indicating a direction of orientation of said liquid crystal in an intermediate portion in a direction of thickness of said liquid crystal device,

wherein $\Delta n d$ lies within a range of 600 to 900 nm, said $\Delta n d$ being the product of a birefringence Δn of said nematic liquid crystal and a gap d between said first transparent substrate and said second transparent substrate,

a method of driving the liquid crystal shutter, comprising the steps of:

assigning a single driving term of said liquid crystal shutter to a scan term during which all pixels or predetermined pixels of said liquid crystal shutter are rendered opened or half-opened, and controlling said scan term, depending on the operating temperature, so as to be lengthened at a time of a low temperature but shortened at a time of a high temperature.

**** R E M A R K S ****

Claims 10 have been canceled and claim 11 has been replaced with new claim 10 to more particularly point out and distinctly claim the subject matter which the applicants regard as their invention. For the Examiner's convenience, a marked-up version showing the present amendments is attached hereto as "Version with Markings to Show Changes Made."

The above amendment is believed to place the claims in proper condition for

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MARKED-UP VERSION SHOWING CHANGES MADE

IN THE SPECIFICATION:

Page 15, beginning on line 9:

-- Fig. 4 shows arrangement angles of the lower polarizing plate 8 and the transmittance of the liquid crystal shutter, obtained when the lower polarizing plate 8 is rotated counterclockwise from the direction 12 in which the intermediate liquid crystal molecules are orientated, with the intersection angle fixed at 90° between the absorption axis 13 of the lower polarizing plate 8 and the absorption [angle] axis 14 of the upper polarizing plate 9 in a 240° twisted liquid crystal device having a value of $\Delta n d$ equal to 800nm.

IN THE CLAIMS:

Please cancel claims 1-3 without prejudice and amend claims 4-18 as follows:

Claim 4. (Amended) In a liquid crystal shutter, including

a liquid crystal device including a nematic liquid crystal sealed in between a first transparent substrate and a second transparent substrate on whose inner surfaces are formed respective transparent electrodes, said liquid crystal device having a twisted angle equal to or greater than 180°, and

a pair of polarizing plates between which are sandwiched said first transparent substrate and said second transparent substrate, said polarizing plates having respective absorption axes which are substantially orthogonal to each other, said absorption axes of said polarizing plates being angled within a range of $\pm 40^\circ$ to $\pm 50^\circ$ relative to a direction in which intermediate liquid crystal molecules are orientated, said direction indicating a direction of orientation of said liquid crystal in an intermediate portion in a direction of thickness of said liquid crystal device,

[A] a method of driving the liquid crystal shutter [according to claim 1, wherein], comprising the steps of:

dividing a single drive term of said liquid crystal shutter [is divided] into a reset term during which all pixels of said liquid crystal shutter are rendered closed and a scan term during which all the pixels or predetermined pixels are rendered opened or half-opened; and

making a [the] duration of said scan term [being made] shorter than a holding time taken for a transmittance of said liquid crystal shutter to start to lower after it has reached its maximum with no driving voltage applied to said liquid crystal shutter.

Claim 5. (Amended) A liquid crystal shutter driving method according to claim 4, [wherein] further comprising:

applying a positive or negative driving voltage [is applied] to said liquid crystal shutter during a partial period with said scan term, setting said driving voltage [being set] to 0V during a remaining period, and varying said period during which said driving voltage is set to 0V [being varied] in order to perform a gradation display.

Claim 6. (Amended) A liquid crystal shutter driving method according to claim 4, [wherein] further comprising:

varying the voltage applied to said liquid crystal shutter in said scan term [is varied] from 0V in order to perform a gradation display.

Claim 7. (Amended) A liquid crystal shutter driving method according to claim 4, [wherein] further comprising:

controlling a single driving term of said liquid crystal shutter [is controlled], depending on an operating temperature, so as to be increased at a time of a low temperature but reduced at a time of a high temperature.

Claim 8. (Amended) In a liquid crystal shutter, including
a liquid crystal device including a nematic liquid crystal sealed in between a first transparent substrate and a second transparent substrate on whose inner surfaces are formed respective transparent electrodes, said liquid crystal device having a twisted angle equal to or greater than 180°, and

a pair of polarizing plates between which are sandwiched said first transparent substrate and said second transparent substrate, said polarizing plates having respective absorption axes which are substantially orthogonal to each other, said absorption axes of said polarizing plates being angled within a range of $\pm 40^\circ$ to $\pm 50^\circ$ relative to a direction in which intermediate liquid crystal molecules are orientated, said direction indicating a direction of orientation of said liquid crystal in an intermediate portion in a direction of thickness of said liquid crystal device,

[A] a method of driving the liquid crystal shutter [according to claim 1, wherein], comprising the steps of:

assigning a single driving term of said liquid crystal shutter [is assigned] to a scan term during which all pixels or predetermined pixels of said liquid crystal shutter are rendered opened or half-opened, and controlling said scan term [being controlled], depending on an operating temperature, so as to be lengthened at a time of a low temperature but shortened at a time of a high temperature.

Claim 9. (Amended) In a liquid crystal shutter, including

a liquid crystal device including a nematic liquid crystal sealed in between a first transparent substrate and a second transparent substrate on whose inner surfaces are formed respective transparent electrodes, said liquid crystal device having a twisted angle equal to or greater than 180° , and

a pair of polarizing plates between which are sandwiched said first transparent substrate and said second transparent substrate, said polarizing plates having respective absorption axes which are substantially orthogonal to each other, and

wherein $\Delta n d$ lies within a range of 600 to 900 nm, said $\Delta n d$ being the product of a birefringence Δn of said nematic liquid crystal and a gap d between said first transparent substrate and said second transparent substrate,

[A] a method of driving a liquid crystal shutter, [according to claim 2, wherein] comprising the steps of:

dividing a single drive term of said liquid crystal shutter [is divided] into a reset term during which all pixels of said liquid crystal shutter are rendered closed and a scan term during which all the pixels or predetermined pixels are rendered opened or half-opened; and making the duration of said scan term [being made] shorter than a holding time taken for a transmittance of said liquid crystal shutter to start to lower after it has reached its maximum with no driving voltage applied to said liquid crystal shutter.

Claim 10. (Amended) A liquid crystal shutter driving method according to claim 9, [wherein] further comprising:

applying a positive or negative driving voltage [is applied] to said liquid crystal shutter during a partial period within said scan term, setting said driving voltage [being set] to 0V during a remaining period, and varying said period during which said driving voltage is set to 0V [being varied] in order to perform a gradation display.

Claim 11. (Amended) A liquid crystal shutter driving method according to claim 9, [wherein] further comprising:

varying the voltage applied to said liquid crystal shutter in said scan term [is varied] from 0V in order to perform a gradation display.

Claim 12. (Amended) A liquid crystal shutter driving method according to claim 9, wherein further comprising:

controlling a single driving term of said liquid crystal shutter [is controlled], depending on an operating temperature, so as to be increased at a time of a low temperature but reduced at a time of a high temperature.

Claim 13. (Amended) In a liquid crystal shutter, including

a liquid crystal device including a nematic liquid crystal sealed in between a first transparent substrate and a second transparent substrate on whose inner surfaces are formed respective transparent electrodes, said liquid crystal device having a twisted angle equal to or greater than 180° , and

a pair of polarizing plates between which are sandwiched said first transparent substrate and said second transparent substrate, said polarizing plates having respective absorption axes which are substantially orthogonal to each other, and

wherein $\Delta n d$ lies within a range of 600 to 900 nm, said $\Delta n d$ being the product of a birefringence Δn of said nematic liquid crystal and a gap d between said first transparent substrate and said second transparent substrate,

[A] a method of driving a liquid crystal shutter, [according to claim 2, wherein] comprising the steps of:

assigning a single driving term of said liquid crystal shutter [is assigned] to a scan term during which all pixels or predetermined pixels of said liquid crystal shutter are rendered opened or half-opened, and controlling said scan term [being controlled], depending on the operating temperature, so as to be lengthened at a time of a low temperature but shortened at a time of a high temperature.

Claim 14. (Amended) In a liquid crystal shutter, including

a liquid crystal device including a nematic liquid crystal sealed in between a first transparent substrate and a second transparent substrate on whose inner surfaces are formed respective transparent electrodes, said liquid crystal device having a twisted angle equal to or greater than 180° , and

a pair of polarizing plates between which are sandwiched said first transparent substrate and said second transparent substrate, said polarizing plates having respective absorption axes which are substantially orthogonal to each other, said absorption axes of said polarizing plates being angled within a range of $\pm 40^\circ$ to $\pm 50^\circ$ relative to a direction in which intermediate liquid crystal molecules are orientated, said direction indicating a direction of orientation of said liquid crystal in an intermediate portion in a direction of thickness of said liquid crystal device,

wherein $\Delta n d$ lies within a range of 600 to 900 nm, said $\Delta n d$ being the product of a birefringence Δn of said nematic liquid crystal and a gap d between said first transparent substrate and said second transparent substrate,

[A] a method of driving a liquid crystal shutter, [according to claim 8, wherein] comprising the steps of:

dividing a single driving term of said liquid crystal shutter [is divided] into a reset term during which all pixels of said liquid crystal shutter are rendered closed and a scan term during which all the pixels or predetermined pixels are rendered opened or half-opened;

making the duration of said scan term [being made] shorter than a holding time taken for a transmittance of said liquid crystal shutter to start to lower after it has reached its maximum with no driving voltage applied to said liquid crystal shutter.

Claim 15. (Amended) A liquid crystal shutter driving method according to claim 14, [wherein] further comprising:

applying a positive or negative driving voltage [is applied] to said liquid crystal shutter during a partial period with said scan term, setting said driving voltage [being set] to 0V during a remaining period, and varying said period during which said driving voltage is set to 0V [being varied] in order to perform a gradation display.

Claim 16. (Amended) A liquid crystal shutter driving method according to claim 14, [wherein] further comprising:

varying the voltage applied to said liquid crystal shutter in said scan term [is varied] from 0V in order to perform a gradation display.

Claim 17. (Amended) A liquid crystal shutter driving method according to claim 14, [wherein] further comprising:

controlling a single driving term of said liquid crystal shutter [is controlled], depending on an operating temperature, so as to be increased at a time of a low temperature but reduced at a time of a high temperature.

Claim 18. (Amended) In a liquid crystal shutter, including

a liquid crystal device including a nematic liquid crystal sealed in between a first transparent substrate and a second transparent substrate on whose inner surfaces are formed respective transparent electrodes, said liquid crystal device having a twisted angle equal to or greater than 180°, and

a pair of polarizing plates between which are sandwiched said first transparent substrate and said second transparent substrate, said polarizing plates having respective absorption axes which are substantially orthogonal to each other, said absorption axes of said polarizing plates being angled within a range of $\pm 40^\circ$ to $\pm 50^\circ$ relative to a direction in which intermediate liquid crystal molecules are orientated, said direction indicating a direction of orientation of said liquid crystal in an intermediate portion in a direction of thickness of said liquid crystal device,

wherein $\Delta n d$ lies within a range of 600 to 900 nm, said $\Delta n d$ being the product of a birefringence Δn of said nematic liquid crystal and a gap d between said first transparent substrate and said second transparent substrate,

[A] a method of driving the liquid crystal shutter, [according to claim 3 wherein], comprising the steps of:

assigning a single driving term of said liquid crystal shutter [is assigned] to a scan term during which all pixels or predetermined pixels of said liquid crystal shutter are rendered opened or half-opened, and controlling said scan term [being controlled], depending on the operating temperature, so as to be lengthened at a time of a low temperature but shortened at a time of a high temperature.